ARMORED MEDICAL RESEARCH LABORATORY

FORT KNOX, KENTUCKY

Final Report On

PROJECT NO. 8 - Preselection Tests

3/17/45

INFORMATION COPY

Action copies have been forwarded to Requirements Section, AGF for approval and execution.

Project No. 8

17 March 1945

ARMORED MEDICAL RESEARCH LABORATORY
Fort Knox, Kentucky

Project No. 8
SPMEA 220.105

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1. PROJECT NO. 8 - Preselection Tests. Final Report.

a. Authority: First Indorsement dated 26 November 1942, by Commanding General, Headquarters Armored Force, Fort Knox, Kentucky, 400.112/6 GNOHD, to Letter Armored Force Medical Research Laboratory dated 10 November 1942.

b. Purpose: (1) To define the requisite qualifications of inductees assigned for training as tank crewmen; and (2) to determine the extent to which one increment of inductees arriving at the Armored Replacement Training Center measures up to these qualifications.

2. DISCUSSION:

a. Tanks are among the most highly specialized weapons of this war. Their effectiveness as a striking force in combat, against the combined hazards of enemy opposition and terrain, requires a high order of competence on the part of the crew. The high initial cost of tanks, plus the expense and effort necessary to keep them supplied and repaired in the theatre emphasizes the need for tank personnel of ability and intelligence. Tanks are never more effective than the men operating them.

b. By the nature of their structural and operating characteristics, armored vehicles impose a requirement for certain specific qualifications on the crew members. These may be grouped under the following headings: intelligence, size, vision, age, and physical and psychologic status.

c. Training at the Armored Replacement Training Center is accomplished with a limited number of cadremen and vehicles. The rate and thoroughness of instruction becomes automatically pitched at the level of the least competent troops both physically and mentally. Every individual who fails to complete the training as a potentially effective tank soldier contributes to the waste of training facilities. The ARTC does eliminate the poorest individuals progressively in the course of training.

d. In order to evaluate the caliber of the inductees arriving at the Armored Replacement Training Center, one entire increment of 608 men was examined on its arrival at Classification during the week of 9 October 1944. This report presents the methods and rationale of the examination, and the information obtained.

e. Adequate studies are not available for proper validation of any preselection standard for armored troops. Consequently, general experience and judgment must be relied on in great part for studies of this type.

3. CONCLUSIONS:

a. Men are being received at the Armored Replacement Training Center whose qualifications for the most part are not up to standards judged necessary for effective tank operation. This is regarded as a partial explanation of the frequency of vehicle failures, and of the habitual failure of many men to satisfactorily complete the course of training.

b. The qualifications of tank crewmen established for this study were:

Age - 30 or under (alternately 25 or under)
AGCT - 90 or above (or alternately 80 or above)
Height - 5'3" to 5'11" inclusive
Weight - 110 to 185 lbs. inclusive
Physical Profile - 2-1-1-1-1-1 or above
Vision -
(1) Acuity in each eye of at least 20/60
(2) Astigmatism in no more than 2 meridians of either eye
(3) Normal color vision
(4) No glasses

c. On the basis of these qualifications, with the age limit at 30, only 17.1% of the 608 men examined are acceptable for training as armored troops. If the age limit is placed at 25, as few as 7.8% are acceptable. However, lowering the AGCT standard to 80, while maintaining the age limit at 30, results in the acceptability of 24.6% of this increment.

d. Psychologic inadequacy, night vision, recovery from glare, and identification of preferential eye were not tested because of limitations in time and equipment.

4. RECOMMENDATIONS:

a. That only those men who have the physical and mental qualifications of tank crewmen, as outlined above, be accepted for training as tank crewmen.

b. That consideration be given to reclassification of men after the sixth week of training at which time the reprofile status as well as performance evaluations by company commanders become available to provide additional bases for eliminating those likely to do poorly in tank driving and gunnery.

NOTE:

Comments by Headquarters Armored Center with reference to this project are contained in the following indorsement.

P-8 (13 Mar 45) GNREA 1st Ind.

HQ ARMD CENTER, Fort Knox, Kentucky, 16 March 1945

TO: Dir, Armd Med Res Lab, Fort Knox, Kentucky.

1. This is an interesting and valuable report. It is believed that it correctly defines the requisite qualifications desirable in inductees assigned for training as tank crewmen.

2. However, if the matter is considered from the point of view of the whole Army rather than for just one arm, it becomes apparent that the majority of the physical and mental requisites set forth herein for tank crewmen are equally desirable in infantry and in other arms. Therefore, in the effort to establish a high qualification or an ideal qualification for personnel of one arm, the question always arises if such a policy isn't a detriment to other arms of equal importance.

3. As I understand the situation today, both the air corps and the navy set up higher physical and mental requisites for personnel and, thus, secure a higher class of personnel than does our ground army. Studies and tests such as this serve a very useful purpose since it can be shown that our Ground Forces are equally in need of the same class personnel.

/s/ C. L. Scott
C. L. SCOTT
Major General, U. S. Army
Commanding

1 Incl. n/c.
(AMRL Proj #8)

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3 Incls.
Appendices I, II & III

APPENDIX I

CONSIDERATIONS REGARDING THE ESTABLISHMENT OF QUALIFICATIONS FOR ARMORED TROOPS

The men received at the Center are directed there to some extent on the basis of their profile classification. Varying with each increment, approximately one third (1/3) have top profile ratings and the other two thirds (2/3) somewhat below this. At the Center, separation of the arrivals into two (2) major groups is made, for assignment to tank training and to specialist schools. The latter group is chosen at present because of lower leadership, intelligence, and physique. The former group includes as many men as possible with civilian driving experience. In this group the further effort is made to identify both potential leaders and those men who are likely to require special attention. Interviews at the Classification Office provide the basis for these allocations.

A more precise method of selection, based on an evaluation of the fundamental qualifications required of successful tank crewmen is presented in this report. It is predicated on the assumption that only men with the attributes suitable for armored personnel should be sent to this Post for training. If this be accomplished, then proper allocation of the men after their arrival can readily be achieved.

The following paragraphs discuss the various physical and mental characteristics regarded as desirable if not essential to the effectiveness of tank personnel.

1. AGCT:

The operation of a tank without accidents and failures demands a degree of intelligence above the average. The motor, suspension system, gun and controls, and radio are of intricate design. Their continued function necessitates the avoidance of misuse, and their successful integration as a formidable weapon demands skill and judgment. Men of low intelligence cannot achieve the understanding necessary for this in the short training period available, nor is it likely that even with longer training they attain a high order of competence.

At present the AGCT scores of the men arriving at the Armored Replacement Training Center average 95, and there are many men who have scores below 75. Even should these low scores represent only language difficulty, yet without the ability to comprehend written instruction, a tank crewman cannot do well. Accordingly, a certain minimum AGCT score appears desirable for armored personnel. Were the choice of men unlimited this minimum should be placed at least at 90; however, it may prove expedient at present to accept men with scores as low as 80, though certainly not lower. Such a requirement is not high compared to the minimum AGCT score of 100 for assignment to training on the less intricate stereo-height finder in the antiaircraft command.

2. Physical Profile:

The physical profile serial number as stated in MR 1-9 which is optimum for combat duty and strenuous activity is 2-1-1-1-1-1. Each of these numbers

represents a factor in general fitness:

a. The first number is intended to classify individuals with regard to a number of important qualifications. They are: height, age, weight, build, strength, stamina, agility, energy, and muscular coordination. Since all of these are of prime importance to tank crewmen, the limits in this category should be specially defined for armored personnel, the general service standards being more liberal than those desirable for armor.

(1) Height and Weight: The interior dimensions of tanks impose important limitations on the size of crew members. If too large, men cannot pass the hatchways readily for either entrance or escape. When the tank is buttoned up, the limited seat to roof height may force tall men to sit in a cramped position, a distinct hindrance to gunners and drivers. Excessive size is equally unsatisfactory for the manipulation of turret controls and for following the telescope downward when the gun is elevated. In some tanks tall gunners have been obliged to manipulate traverse and elevating wheels by crossing their arms. Tall or broad-shouldered gunners have insufficient room between the gun breech and the turret wall, and large loaders are slowed down when their tanks are fully stowed. Men who are too short have difficulty as drivers in reaching clutch pedals, and as gunners in keeping their feet securely braced on the floor when the seat is in the up-position. Moreover, men who are severely underweight do not possess sufficient stamina for protracted tank duties. In view of these considerations it seems advisable to stipulate the height limits for tankers as between 5'3" and 5'11" and the weight limits as between 110 and 185 lbs., both inclusive.

(2) Age: Experience indicates that younger men perform more satisfactorily in tanks. The actual age limit cannot be properly defined without an analysis of the percentages of non-battle ineffectives by age group. For this study the men were classified on the basis of age limits at 30 years and also at 25 years. Other studies at the laboratory suggest that physical fitness for some types of exercise is greater without training for men up to 25 years of age, but can be achieved with training by men up to 30 years of age, while beyond this age, the level of achievement is less. It may not be inferred, however, that physical fitness as measured by the standard exercise tests, may be used as a complete criterion of performance in tanks.

b. The second and third numerals pertain to the upper and lower extremities respectively, a score of "1" indicating the absence of bone, muscle, and joint defects.

c. The fourth numeral evaluates the hearing. Because earphones must be used in tanks in the presence of a high general noise level, hearing in the conversational range should be unimpaired, and a rating of "1" required.

d. Vision is rated by the fifth numeral in the series. It was specially examined in the tests being reported, and will be discussed in detail below.

e. The final profile serial number describes the neuropsychiatric status. It is obvious that only emotionally stable individuals with a rating of "1" are suitable as tank personnel.

3. The Wearing of Glasses:

At present no restriction is placed on the use of glasses by armored troops. Yet inside tanks they interfere with the use of periscopes and telescopes; they are subject to breakage; and the likelihood of eye injury, when glasses are broken by flying fragments in combat, is increased. For these reasons the wearing of glasses inside tanks should be prohibited. The vision standards outlined in the next paragraph are such as to admit some individuals with moderate opthalmic defects to tank training without the use of their glasses inside tanks.

4. Vision:

The Army general service standard for vision is described in terms of visual acuity only, and a profile serial number of "1" indicates vision of 20/200, correctible to 20/40. The visual tasks required of armored troops are recognition of targets and range estimation at distance, reading of dials, (azimuth indicator, gun quadrant, driver's panel), definition of reticle patterns, and reading of maps and of printed instruction material. These take in the entire range of visual performance, demanding a high order of ability at both far and near. Obviously 20/200 vision is insufficient. Accordingly, an arbitrary limit was set for the purpose of this study of at least 20/60 in either eye, with the added permission of astigmatism in 2 meridians in either eye, but with normal color vision required. The need for normal color vision has not been validated, however.

These requirements are liberal, perhaps excessively so. By comparison, 20/20 vision is demanded for all air personnel, in the navy, and for training on stereo-height finders in the antiaircraft command.

Phoria defects and stereopsis failures were examined for in this study. However, such defects were never found to exist except in the presence of other defects in acuity, astigmatism, or obvious strabismus. Accordingly, it is felt that requirements in terms of acuity, astigmatism, and color vision sufficiently express the needs of armored troops. These attributes may be rapidly examined for, either with the Keystone "Telebinccular" which was used for this study or with the Bausch and Lomb "Orthorater".

5. Other Selection Standards:

Because of lack of time and equipment, night vision, glare recovery, time, and identification of the preferential eye (important in the use of the telescope by gunners) were not examined on this group of men. They all have a bearing on the effectiveness of tank crewmen, and should be considered for

inclusion in preselection tests. Muscle coordination and facility in the use of mechanical equipment are similarly important, but tests for these attributes are difficult to administer and interpret. Observation by watchful instructors in the course of training can effectively evaluate such characteristics.

6. Summary:

The foregoing in effect describes a possible revision of the physical profile for armored personnel. In summary it may be stated as follows:

P - Physical Capacity - Ability to perform sustained effort, age not over 30, height 5'3" to 5'11", inclusive, weight 110 to 185 lbs. inclusive, and muscular coordination.

U - Upper Extremities - Bones, joints, and muscles normal.

L - Lower Extremities - Bones, joints, and muscles normal.

H - Hearing - 15/15 in one ear, and 8/15 or better in the other.

E - Vision - Acuity of not less than 20/60 in either eye; astigmatism in no more than 2 meridians in either eye; normal color vision; no glasses.

S - Neuropsychiatric - Emotionally stable, and in addition: -- Intelligence - AGCT preferably over 90, but in no case under 80.

APPENDIX II

STUDY OF PHYSICAL ATTRIBUTES OF ARTC TRAINEES

The results of the study of one entire increment of 608 trainees at the Classification Office of the ARTC during the week of 9 October 1944 are given below. The records of the men are analyzed in accordance with the standards outlined in the preceding section.

Information with regard to age, AGCT, height, and weight was obtained from the form 20 of each man. Vision data were obtained by administering to each individual the standard Keystone "Telebinocular" tests for acuity, astigmatism, heterophoria, and stereopsis. Color vision was tested with a selected group of Ishihara confusion color plates as published by the American Optical Company. This is only a gross exclusion test, but was deemed adequate for the present purpose.

Table 1 presents a summary of the entire examination of the increment to indicate the number and percent of men suitable for training. Table 2 is a presentation of the frequency of disqualifying attributes of these men. Table 3 indicates the extent to which the co-existence of more than one defect in many subjects influences the selection of acceptable trainees.

TABLE 1

ACCEPTABLE TRAINEES AMONG 608 MEN OF ONE INCREMENT

Number	Percent	Remarks
48	7.8	Age 25 or less, AGCT 90 or above, proper height, weight, vision and physical profile.
104	17.1	Age 30 or less, AGCT 90 or above, proper height, weight, vision, and physical profile.
150	24.6	Age 30 or less, AGCT 80 or above, proper height, weight, vision, and physical profile.

TABLE 2

ANALYSIS OF DEFECTS AMONG TRAINEES AT THE ARTC

Number	Percent of Total Defects	Type of Disqualifying Attributes
263	27.8	Below physical profile 2-1-1-1-1-1
40	4.2	Weight below 110 lbs. or above 185 lbs.
65	6.9	Height below 5'3" or above 5'11"
242	25.6	AGCT below 90
196	21.8	AGCT below 80
161	17.0	Age above 25
105	11.8	Age above 30
21	2.2	Visual acuity below 20/60 in either eye
52	5.5	Astigmatism in more than 2 meridians in either eye
65	6.9	Additional men with co-existent visual acuity and astigmatic defects
30	3.2	Faulty color vision without other vision defects
5	.5	Other visual defects

THE TOTAL NUMBER OF DISQUALIFYING ATTRIBUTES AMONG 608 MEN IS:

946 - When upper age limit is 25 years and lower AGCT limit is 90
845 - When upper age limit is 30 years and lower AGCT limit is 80

TABLE 3

ANALYSIS OF THE ATTRIBUTES OF ONE INCREMENT OF TRAINEES ARRANGED TO INDICATE THE CO-EXISTENCE OF MORE THAN ONE DEFECT IN MANY INDIVIDUALS

Number	Percent	
48	7.8	Age 25 or less, AGCT 90 or above, proper height, weight, vision, and physical profile
161	26.4	Over Age 25 - otherwise passing
	33 5.4%	- Age 26 - 30
	23 3.7	- Age 26 - 30 - with other minor defects
	105 17.2	- Age 26 - 38 - with other major defects
201	33.0	Under Age 26 - AGCT under 90
	9 1.4%	- AGCT 85 - 89
	8 1.3	- AGCT 80 - 84
	29 4.7	- AGCT 80 - 89 - with other minor defects
	26 4.2	- AGCT less than 80
	129 21.2	- AGCT less than 90 - with other major defects
35	5.7	Under Age 26 - AGCT over 90, but too tall or too short
	11 1.8%	- Defects of height only
	24 3.9	- Defects of height plus other defects
22	3.6	Under Age 26 - AGCT over 90, proper height, but overweight or underweight
	6 1.0%	- Weight over 185 or under 110
	16 2.6	- Weight over 185 or under 110 - plus other defects
95	15.6	Under Age 26 - AGCT over 90, proper height and weight, but deficient as to profile--below 2-1-1-1-1-1
	6 1.0%	- 1-1-2-1-1-1 only
	2 .3	- 1-2-1-1-1-1 "
	17 2.7	- 2-1-2-1-1-1 "
	5 .8	- 2-2-2-1-1-1 "
	18 2.9	- 3-1-1-1-1-1 "
	1 .2	- 3-1-2-1-1-1 "
	1 .2	- 3-1-3-1-1-1 "
	45 7.4	- Below 2-1-1-2-1-1 with other major defects
46	7.5	Under Age 26 - AGCT over 90, proper height, weight and profile, but with defective vision, without glasses
	3 5%	- Acuity defects
	8 1.3	- Astigmatic defects
	3 .5	- Stereopsis defects
	5 .8	- Color defects
	27 4.4	- Multiple visual defects

In the following three (3) tables are given more complete analyses of Vision Examinations performed on the men in this study. As previously mentioned, these tests were administered with the Keystone "Telebinocular" equipment. Table 4 presents the distribution of visual acuity, Table 5 of astigmatism, Table 6 of Color vision, while Table 7 is a composite analysis of the visual defects of all men whose acuity is below 20/60 in either eye, or who have astigmatism in more than 2 meridians in either eye, or who are color blind. It is noted in Table 7 that for vision defects alone, below the standard established, 22% of the men are excluded.

TABLE 4

VISUAL ACUITY OF ONE INCREMENT OF ARTC INDUCTEES

Snellen Ratings of Acuity without Glasses	Right Eye No.	Right Eye %	Left Eye No.	Left Eye %
20/10	4	0.7	4	0.7
20/12	107	17.6	110	18.1
20/20	283	46.5	283	46.5
20/33	76	12.5	75	12.3
20/45	64	10.5	39	6.4
20/60	25	4.1	47	7.7
20/75	18	3.0	18	3.0
20/200	6	1.0	8	1.3
20/122	4	0.7	4	.7
20/150	8	1.3	2	.4
20/200	4	0.7	4	.7
Less than 20/200	9	1.5	14	2.3
Total	608	100.1	608	100.1

TABLE 5

ASTIGMATISM IN ONE INCREMENT OF ARTC INDUCTEES

Astigmatism	Right Eye No.	Right Eye %	Left Eye No.	Left Eye %
No defect	448	73.7	448	73.7
Defect in 1 Meridian	48	7.9	52	8.5
" in 2 Meridians	39	6.4	42	6.9
" in 3 "	32	5.3	32	5.3
" in 4 "	17	1.8	9	1.5
" in 5 "	6	1.0	4	0.7
" in 6 "	20	3.3	21	3.5
Total	608	99.4	608	100.1

TABLE 6

COLOR BLINDNESS IN ONE INCREMENT OF ARTC INDUCTEES

	Number	Percent
No color blindness	568	93.4
Color blind	40	6.6
Total	608	100.0

The separate analyses for heterophoria, heterotropia, and failure of stereopsis are omitted inasmuch as these defects were found only in those men in whom marked ametropia was also present. Consequently binocular visual defects probably do not have to be tested since simpler exclusion tests seem to serve satisfactorily. The rare exception to this lies in the occasional instance of monocular suppression of the visual image which, however, is usually associated with obvious squint.

TABLE 7

NATURE OF UNACCEPTABLE VISION DEFECTS AMONG 608 INDUCTEES AT ARTC ON THE BASIS OF STANDARDS DESCRIBED ABOVE

Acuity defects alone	33
Acuity defects plus astigmatism	22
Acuity defects plus fusion failure	3
Acuity defects plus color blindness	4
Acuity defects plus astigmatism, plus fusion failure	8
Acuity defects plus astigmatism, plus color blindness	3
Astigmatism alone	26
Astigmatism plus fusion failure	2
Astigmatism plus color blindness	3
Color blindness alone.	30
Total	134 - 22%

APPENDIX III

ADDITIONAL DATA ON RESULTS OF REPROFILE EXAMINATIONS

At the termination of their sixth week of basic training, trainees at the ARTC are reprofiled. Reprofile records were accordingly obtained for the group of men examined at Classification during the week of 9 October 1944, who were the subjects of this study.

TABLE 10

SUMMARY OF PROFILE STATUS OF MEN FOLLOWING RE-EXAMINATION AFTER 6 WEEKS TRAINING

	No. of men		Percent
Profile No. raised to 2-1-1-1-1-1 or above	153		
No change in Profile No. previously 2-1-1-1-1-1 or above	229		
		382	71.4
Profile No. lowered below 2-1-1-1-1-1	51		
Profile No. unchanged from previous level below 2-1-1-1-1-1	102		
		153	28.6
Total		535	100.0
Transferred, absent or discharged		68	
Grand Total		603	

As pointed out in Appendix II, 43.3% of the men had profile serial numbers below the acceptable standard at the time of their arrival at the Center. After 6 weeks, upon re-examination, 28.6% of the men who remained in training with their original increment were still below the permissible level. On the other hand, after re-examination, approximately 25% of the men had higher profile serial numbers, while only about 8% had lower profile numbers. Thus it appears that a period of training is necessary before the physical status of some men can be properly evaluated.